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ABSTRACT

Over the past decade, vocational and technical education teachers were encouraged to use commercially produced task lists to develop their curriculum materials. Unfortunately, however, many commercially developed task lists distributed by private companies, state departments of education, universities, and many other agencies may, to some extent, inhibit rather than promote the smooth flow of true cumulative learning progression. Throughout the history of the competency-based education movement, teachers have usually developed their own hierarchy of tasks with the help of advisory committees. Teachers also worked in small groups to develop mutually accepted competency lists in specific occupational areas. Today, with the increased use of commercial ready-made materials, many teachers no longer feel the need for thinking through their own curriculum approaches. Although it is true that many commercially produced task lists have been subjected to extensive industry validation, including field reviews, they often include tasks that are far too complex to be considered teaching tasks for a school situation. Vocational teachers should remember that, although industry-validated task lists are valuable sources of insight on employers' needs, any task list for a specific vocational program must be developed with consideration of the educational needs and levels of the students who will be mastering the tasks. (MN)

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WHEN IS A TASK A TASK?

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WHEN IS A TASK A TASK?

Synopsis

Over the past decade vocational and technical education teachers were encouraged to use commercially produced task lists to develop their curriculum materials. This writing will demonstrate that the many commercially developed task lists distributed by private companies, State departments of education, universities and many other agencies may, to some extent, inhibit rather than promote the smooth flow of true cumulative learning progression. The aforementioned situation has occurred because of what appears to be confusion in recognizing that tasks for some students are sub-tasks for others and vice versa. A careful analysis of the task structure will show there is a continuous hierarchy in cumulative learning wherein each task becomes part of a larger whole. Hence, complete reliance on commercially developed materials may result in a loss of both teaching and learning efficiency.

Perspective

The competency based education (CBE) movement brought with it the need for the task list as a central component of the system (Pucel and Knaak, 1979). A review of the literature has shown that the concept of task lists is not really new. The Russian system of manual training, developed by Della Vos in the 1870's, was competency based in the sense

that each new exercise was built upon the cumulative learning which the student had developed in a previous exercise. These exercises (tasks) were recorded upon completion, for each student. Each new exercise, in turn, was carefully analyzed so constant cumulative skill development was assured (Bennett, Vol. II, 1937). A decade later Woodward and Runkle pioneered in developing a similar systematic task approach to teaching shop subjects in this country at Washington University and The Massachusetts Institute of Technology (Barlow, 1967).

In 1917 Allen (1922) brought a cumulative learning system to World War I training programs in the ship building industry. He employed observers to analyze all the steps, sub-steps and safety required for major production jobs. These observed behaviors were placed into logical cumulative learning order so accurate training plans could be developed. His motive was to provide learning efficiency which would enhance the war production effort. The "hit or miss" approach of learning on the job had now evolved into an analytical, sequentially planned system. Allen received meritorious acclaim for his contribution to the industrial training of that era.

Later Selvidge (1923) brought a job/step breakdown system into the secondary schools, building on Allen's industry approach. Additionally, he pioneered the progress chart, still found on many bulletin boards in our school laboratories today. Each new job (known as task today) on

the chart was built upon operations learned in previous jobs. Furthermore the wall progress chart provided a competitive motivation to students. Today, of course, public display of student progress is frowned upon because the motivation provided for better students is counterbalanced by the opposite effects the chart can have on less able students.

Fryklund (1942) devised a more detailed analytical system of classifying jobs, operations, steps, topics and key points cumulating into what is known today as job (occupational) analysis. As president of Stout Institute in Menomonie, Wisconsin, he was in an excellent position to promote his organizational concept. He influenced the development of collegiate teacher education programs, particularly in the areas of industrial arts and trade and industrial education (T & I).

Throughout the evolutionary period of competency based education dating from Della Vos in the late 1800's to the Fryklund era (1942 to the mid-seventies), most of the writings and development were done for industrial arts/T & I education and other areas where tool and machine use were prominent. During the 1970's other groups began experimenting with competency based education, developing many different approaches (Pucel and Knaak, 1979). State departments of education began recommending or mandating various CBE systems based upon a variety of analysis systems. Eventually a duplication of effort occurred and consortiums banded together to produce commercially available competency

lists. These lists were often copied verbatim by teachers and accepted unquestioningly as models to follow.

This brief chronology, over one-hundred years in its development, brought with it contemporary problems for teachers who were required to change their curriculum formats, sometimes repeatedly, to meet the varied CBE systems mandated by a state or locality.

The Cumulative Nature of Tasks

Throughout the history of the analysis/CBE movement, teachers usually developed their own hierarchy of tasks with the help of advisory committees. Teachers also worked in small groups at local or state meetings to develop mutually accepted competency lists in specific occupational areas. Today, with the increased usage of commercial ready-made materials, many teachers no longer feel a need for thinking through their own curriculum approaches. After all, commercially developed task lists were validated by industry, so credence for a teaching situation had already been established.

Now, as teachers rely more on commercial materials which are not oriented to a personal teaching situation, there is a need for understanding the cumulative nature of tasks needed for organizing their curriculum materials. (Fig. 1).

Insert Figure 1 about here

Please note that task 1 Sweat Solder a Seam is sufficiently complex to be considered a task in its own right. For the beginning student this task is of such

difficulty that (1) the teacher will give a demonstration and (2) the teacher will want to evaluate a student's ability to perform that task and record it on the student competency list.

After a period of practicing task 1, Sweat solder a seam along with other previously learned tasks, i.e., Measure with a scale, Cut metal to size, etc., the student is ready for a demonstration on task 2, Make a lock joint. Note that step 7 in the aforementioned task was task 1, Sweat solder a seam.

As the student progresses and eventually checks out on Make a lock joint, this task becomes step 4 in task 3, Construct a 36" x 42" metal roof panel, encompassing all of the steps accomplished in the previous task. Task 3 could ultimately become part of a still larger task titled, Install sheet metal roofing. Other cumulative tasks (i.e. Flash around chimney, etc.) could be added as the instruction becomes more advanced.

Essentially then, tasks continue to become steps in larger tasks as the student masters them with sufficient skill. The cumulative learning concept is so essential if efficiency in teaching and learning is to take place. This principle has been practiced in all academic subjects for centuries (Frykund, 1976). In mathematics we proceed through whole numbers, addition, subtraction, multiplication, division, fractions, decimals, etc., in a cumulative order. The same concept is true for English and other academic subjects.

Contemporary literature does indeed recognize that there are task steps (also known as operations, subtasks or elements) (Bartel 1976) but few of the contemporary commercial task lists show concern for this phenomenon. The Vocational Technical Consortium of States (VTECS), for example, compiles tasks based upon thorough industry validation, including field reviews. Many of the VTECS tasks are far too complex, in terms of the aforementioned cumulative learning concept, to be considered teaching tasks for a school situation. Take for example Auto Body Repair, Task No. 16, Weld frames or frame horns (V-TECS, 1979). This task, if broken down into elements which should have proceeded it, could include any or all of the typical tasks shown in Figure 2. These are the tasks which are commonly found on an auto body welding unit competency list.

Insert Figure 2 about here

They must be mastered before the student could be expected to weld in a commercial or "live work" situation. Yet, the task Weld frames or frame horns does not consider the cumulative nature of all learning which must have proceeded it. This paucity of concern for providing a cumulative learning system confuses the new teacher who desperately needs guidance on how to order the sequence of teaching tasks. Basically, then, a series of tasks listed in a commercial guide is quite meaningless unless there is also an analysis of the operations (steps and/or cumulative steps).

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Materials developed by the Mid-America Vocational Curriculum Consortium (MAVCC, 1988), Curriculum Instructional Materials Center (CIMC, 1988) and other similarly constructed guides have the job (task) sheets placed in progressive order throughout the guides, however, there is little explanation in terms of which jobs appear as operations in more advanced jobs. Tasks, sub-tasks (steps) and further breakdowns all appear to be jumbled together without a cumulative analysis for teaching purposes. Some steps on the aforementioned job sheets are indeed large enough to be taught as demonstrations in their own right. In such cases they should have been taught previously.

Where Do We Go From Here?

The concept of cumulative task development somehow appeared to get lost in the competency based education movement. Perhaps it is time to go back to basics as perceived by Allen, Selvidge, Fryklund and other pioneers in the occupational analysis/CBE conceptualization. We need to examine the cumulative learning progression by plotting graphically which steps are found in which jobs (tasks) and then proceed to set up a sequence based upon this type of analysis.

The Fryklund (1970) approach for doing this type of charting is shown in Figure 3. The process is done as follows:

Insert Figure 3 about here

1. Make a laundry list of tasks (completed units of work).
2. Make a laundry list of operations which must be mastered in order to perform the larger tasks listed in Step 1.
3. List the tasks horizontally along the top of the chart.
4. List the operations vertically along the left side of the sheet.
5. Check off which operations are found in each of the tasks.
6. Rearrange the tasks at the top of the chart in order from simple to complex (depending on the number of operations involved).
7. Arrange the operations in order of frequency (most frequent at the top down to least frequent at bottom).
8. Place numbers vertically in the squares to indicate cumulative learning order.

One can now see (a) the order of difficulty (b) the operations which must be taught first and (c) the cumulative nature of instruction.

Note in Figure 4 the cumulative order of tasks and operations delineated from an analysis chart on exploratory sheet metal. Please observe that tasks become cumulatively more difficult, requiring a mastery of operations learned previously plus several new ones. In this particular

Insert Figure 4 about here

analysis, however, tasks 5 and 6 do not include new operations. These are called plateau tasks (projects). They allow the student to gain repetitive practice (drill) on operations previously learned. It is important for the teacher to utilize plateau tasks so that subconscious habit in tool use can be developed. Eventually, if enough practice is given, habit will "take over" for all of the previously taught operations.

If the aforementioned approach is observed, the teacher can teach in an orderly fashion always knowing that there are no gaps or needless overlap in instruction. Essentially, the described approach makes teaching a more efficient and exact science.

Summary

Contemporary commercial curriculum materials are built upon tasks as defined by industry needs rather than instructional needs. The original concept of a hierarchy of tasks which is cumulative in nature has been all but forgotten. Industry tasks need to be further analyzed to produce the order in which operations should be taught. The simple analysis charting system, a product of the 1940's is one way of ensuring that learning progresses cumulatively and that instruction is more efficient. The teacher should select plateau tasks from the chart which aid students to develop habit formation in tool use.

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FIGURES

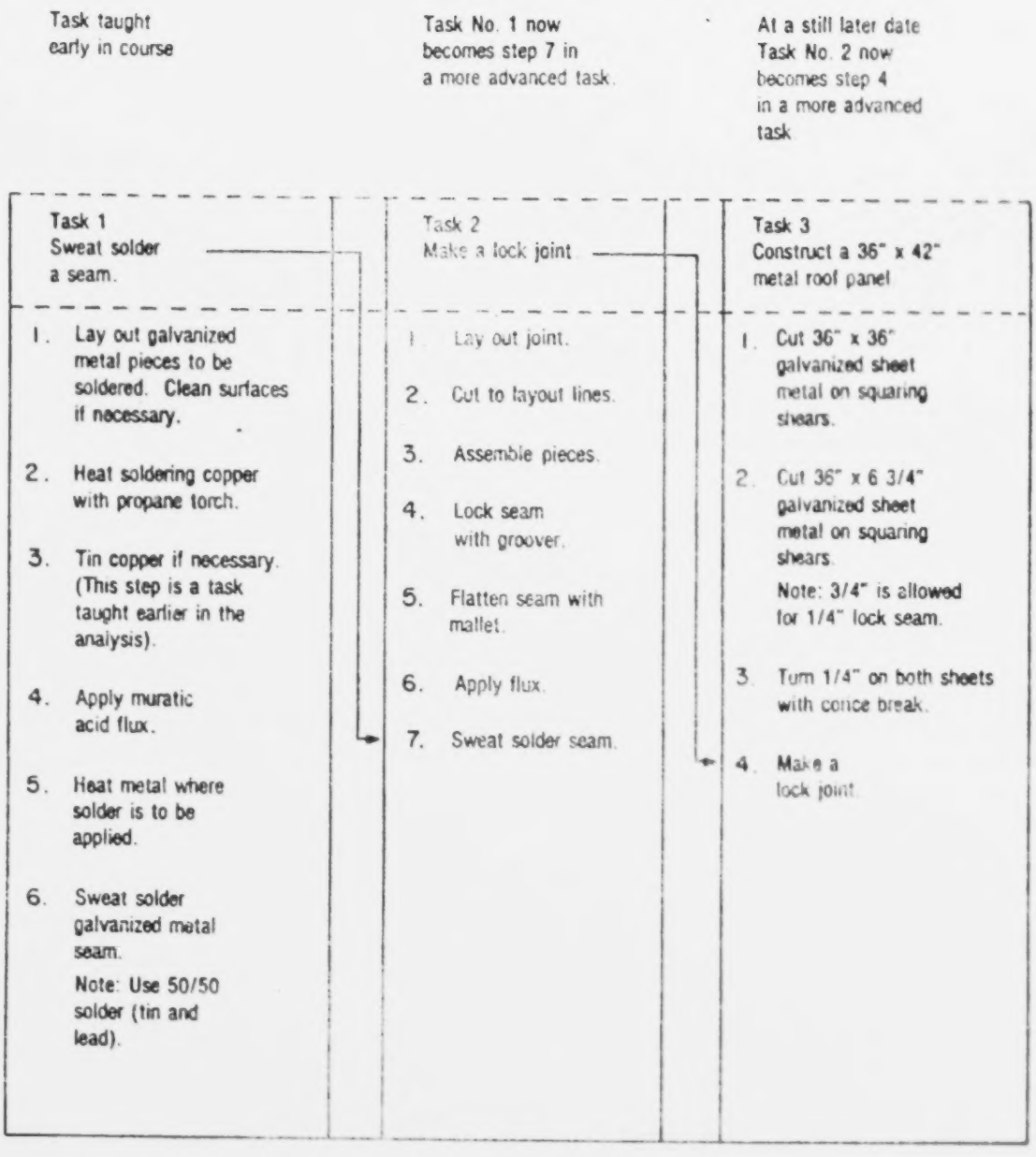
Task taught early in course
Task No. 1 now becomes step 7 in a more advanced task.
At a still later date Task No. 2 now becomes step 4 in a more advanced task
Task 1
Sweat solder a seam.
1. Lay out galvanized metal pieces to be soldered. Clean surfaces if necessary.
2. Heat soldering copper with propane torch.
3. Tin copper if necessary. (This step is a task taught earlier in the analysis).
4. Apply muratic acid flux.
5. Heat metal where solder is to be applied.
6. Sweat solder galvanized metal seam.
Note: Use 50/50 solder (tin and lead).
Task 2
Make a lock joint.
1. Lay out joint.
2. Cut to layout lines.
3. Assemble pieces.
4. Lock seam with groover.
5. Flatten seam with mallet.
6. Apply flux.
7. Sweat solder seam.
Task 3
Construct a 36" x 42" metal roof panel
1. Cut 36" x 36" galvanized sheet metal on squaring shears.
2. Cut 36" x 6 3/4" galvanized sheet metal on squaring shears.
Note: 3/4" is allowed for 1/4" lock seam.
3. Turn 1/4" on both sheets with conce break.
4. Make a lock joint.

Figure 1. The Cumulative Nature of Tasks.

Units	Task No.	Task
1. ARC WELDING FLAT POSITION	1 - 1	Stringer bead 1/8 6013
	1 - 2	Restart cont. bead 1/8 6013
	1 - 3	Weave 1/8 6013
	1 - 4	Lap weld 1/8 6013
	1 - 5	Lap weld 1/8 7018
	1 - 6	Lap weld 1/8 7024
	1 - 7	Lap weld 3/16 6010
	1 - 8	Fillet weld 1/8 6013
	1 - 9	Fillet weld 1/8 7018
	1 -10	Fillet weld 5/32 7024
	1 - 11	Fillet weld 3/16 6010
	1 - 12	V-butt weld 1/8 7018
	1 - 13	Square butt 1/8 6010
2. ARC WELDING VERT. POSITION	2 - 1	Vertical up bead 1/8 6010
	2 - 2	Vertical up weave 1/8 6010
	2 - 3	Vertical up lap 1/8 6010
	2 - 4	Vertical up lap 1/8 7018
	2 - 5	Vertical up fillet 1/8 6010
	2 - 6	Vertical up fillet 1/8 7018
	2 - 7	Vertical up V-butt 1/8 7018
	2 - 8	Vertical down lap 1/8 6010
	2 - 9	Vertical down fillet 1/8 6010
3. ARC WELDING HORIZONTAL POSITION	3 - 1	Horizontal bead 1/8 6010
	3 - 2	Horizontal weave 1/8 6010
	3 - 3	Horizontal lap 1/8 6013
	3 - 4	Horizontal lap 1/8 7018
	3 - 5	Horizontal lap 1/8 7024
	3 - 6	Horizontal lap 1/8 6010
	3 - 7	Horizontal fillet 1/8 7014
	3 - 8	Horizontal fillet 1/8 7018
	3 - 9	Horizontal fillet 5/32 7024
	3 - 10	Horizontal fillet 3/16 6010
	3 - 11	Horizontal V-butt 1/8 7018
4. ARC WELDING OVERHEAD POSITION	4 - 1	Overhead bead 1/8 6010
	4 - 2	Overhead weave 1/8 6010
	4 - 3	Overhead lap 1/8 6010
	4 - 4	Overhead lap 1/8 7018
	4 - 5	Overhead fillet 1/8 6010
	4 - 6	Overhead fillet 1/8 7018
5. ARC WELDING PIPE WELDS	5 - 1	Roll butt weld
	5 - 2	Vertical up butt
	5 - 3	Vertical down butt
	5 - 4	Horizontal butt

Figure 2 Typical Elemental Welding Tasks

Operations	Tasks																							
	1 Bolts, Nuts & Screw	2 Screw Fastenings	3 Lock Nut	4 Pipe Connection	5 Manhole & Pipe Fl.	6 Universal Coupling	7 Arm Pulley	8 Pulleys for Camshaft	9 Ring Oil Bearing	10 Spur Gear	11 Involute Rack	12 Bevel Gear	13 Rack & Pinion	14 Bevel Gear & Pinion	15 Uniform Motion Cam	16 Harmonic Motion Cam	17 Var. Motion Cam	18 Plate Cam	19 Crankshaft	20 Connecting Rod	21 Piston	22 Reversing Mech.	23 Transmission Box
1 Prepare for Drawing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2 Choose Necessary Views	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3 Plan Drawing & Make Layout	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4 Draw Vertical Lines & Angles	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5 Draw Horizontal Lines	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6 Draw Parallel Lines	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
7 Letter	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
8 Dimension A Drawing	8	8	8	8	8	8	8	8		8		8	8	8	8	8	8	8	8	8	8	8	8	8
9 Make Arrow Heads	9	9	9	9	9	9	9	9		9		9	9	9	9	9	9	9	9	9	9	9		9
10 Make Numerals	10	10	10	10	10	10	10	10		10		10	10	10	10	10	10	10	10	10	10	10	10	10
11 Check a Drawing	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
12 Block Out Views	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
13 Block in Drawing With Instru.	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
14 Draw One View	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
15 Draw Two Views	15	15	15	15	15	15		15	15	15					15	15			15	15	15	15		
16 Draw Three Views				16	16			16							16	16				16	16			
17 Draw Hidden Lines	17	17		17	17	17	17	17					17	17	17	17	17	17	17	17	17	17	17	17
18 Draw Arcs & Curves	18	18	18	18	18	18	18	18	18	18		18	18	18	18	18	18	18	18		18	18	18	18
19 Draw Lines Tangent to Circle	19	19		19	19	19	19	19				19	19	19	19	19	19	19		19	19			
20 Draw Tangent Arcs	20	20	20	20	20		20		20			20	20	20	20	20	20	20			20		20	
21 Draw a Hexagon	21	21	21	21		21		21				21								21	21	21		
22 Draw a Keyway					22		22	22	22	22	22	22	22	22	22	22	22	22		22	22	22	22	22
23 Draw Screw Threads	23	23	23	23	23	23		23	23											23	23	23	23	23
24 Space With Dividers	24	24	24	24	24		24	24	24	24	24	24	24	24		24	24	24		24	24	24	24	24
25 Trace		25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
26 Make a Print		26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26		26	26	26	26	26
27 Make a Detail Drawing					27	27	27	27			27				27	27		27	27	27	27	27	27	27
28 Draw Fillets						28	28	28		28	28	28	28	28	28	28		28	28	28	28	28	28	28
29 Draw Pitch Lines						29				29	29	29	29	29	29	29		29	29		29	29	29	29
30 Draw Addendum Lines									30	30	30	30	30						30		30	30	30	30
31 Draw Dedendum Lines									31	31	31	31	31								31	31	31	31
32 Draw Gear Teeth									32	32	32	32	32								32	32	32	32
33 Letter Notes & Spec.								33	33	33	33		33	33	33	33	33	33	33	33	33	33	33	33
34 Draw Irregular Curves							34	34				34		34	34	34	34		34	34		34		34
35 Draw a Line of Action									35	35		35	35	35	35	35	35			35		35		35
36 Draw Involute Curves									36	36	36	36	36	36	36	36	36		36	36		36		36
37 Develop a Cone											37								37	37	37		37	
38 Project a Drawing											38		38							38	38			
39 Draw A Diagram of Motion											39		39	39	39	39	39			39	39			
40 Make Radial Lines														40	40	40	40			40	40			
41 Draw Thread Angles																			41	41	41			
42 Draw Hilex Angles																			42	42	42			
43 Make an Assembly Drawing																			43		43			
44 Draw an Auxiliary View																								
45 Draw an Octagon																								

Figure 3. Analysis of Machine Drawing

Task	Operations
Construct a:	
1. Drive cleat	1-1 Measure and scribe lines 1-2 Straight cut with snips 1-3 Cut with squaring shears 1-4 Lay out and form hem
2. Metal drawer	Includes operations 1-1, 1-2, 1-3 plus 2-1 Lay out rectangular work 2-2 Transfer a pattern to metal 2-3 Make a lap seam 2-4 Solder a lap seam 2-5 Dot pattern with prick punch 2-6 Form square corner bend 2-7 Dress up on square stake
3. Funnel	Includes all previous operations except 1-4, 2-5, 2-6, 2-7 plus 3-1 Notch for irregular cuts 3-2 Bend wire to pattern 3-3 Form cylinder with slip roll
4. Square Scoop	Includes all previous operations except 1-4, 2-1, 2-3, 2-4, 3-3 plus 4-1 Make grooved seam 4-2 Solder grooved seam 4-3 Dress corners 4-4 Burr on burring machine 4-5 Make double hem 4-6 Slit with slitting punch 4-7 Mark parallel lines
5. Pastry Cutter	Plateau project, no new operations
6. Dust pan	Plateau project, no new operations
7. Round scoop	Includes all previous operations except 1-4, 2-5, 2-6, 3-1, 3-2, 3-3, 4-5 plus 7-1 Make conical development pattern 7-2 Cut inside diameter 7-3 Make a double hem

Figure 4. Pleateau Tasks Included in a Cumulative Order Analysis